

NUCLEAR CHIRALITY

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Nuclear chirality is a recently discovered manifestation of spontaneous symmetry breaking [1] resulting from an orthogonal coupling of angular momentum vectors in triaxial nuclei. Three perpendicular angular momenta can form two systems of the opposite handedness; the time reversal operator, which reverses an orientation of each of the components, relates these two systems. Spontaneous formation of chirality is uniquely different from other forms of spontaneous symmetry breaking, in particular from the space inversion symmetry breaking, is in the fact that the eigen states of the time reversal operator can not be formed. Consequently there is no quantum number, that can be used to label the chiral states.

Experimentally doublet partner bands resulting from nuclear chirality were first investigated in odd-odd $\pi h_{11/2} (\nu h_{11/2})^{-1}$ configurations in the $A \sim 130$ region [2] with three angular momentum vectors provided by the valence proton, valence neutron and the core rotation. Subsequently, chiral partner bands in the odd-mass nucleus ^{135}Nd [3] were reported indicating that one of the angular momentum components for the chiral systems can be provided by a pair of aligned high-j particles. This observation emphasize the geometrical interpretation of nuclear chirality as a consequence of the tilted total angular momentum of a nucleus with respect to the three principal axes of a triaxial mass distribution. Recent experimental efforts have led to the identification of chiral partner bands in odd-odd ^{104}Rh [4] and ^{106}Rh [5] based on the $(\pi g_{9/2})^{-1} \nu h_{11/2}$ configuration and in the $(\pi g_{9/2})^{-1}$ band in odd- A ^{105}Rh [6] after the alignment of a pair of the $h_{11/2}$ neutrons. Identification of this new region of doublet structures indicates that chiral properties are of a general nature and should be expected in transitional triaxial nuclei throughout the nuclear landscape. The small energy separation of the two bands in ^{104}Rh (~ 2 keV at spin 17 \hbar) provides the best example of degeneracy and stability of the triaxial core observed up to date. In ^{105}Rh chiral bands and a γ -band have been identified, which allows us to address triaxial features of the both bands in the same nucleus.

Identification of partner band structures prompted a search for experimental observables, which can be uniquely related to nuclear chirality. Particle-rotor model calculations for odd-odd nuclei have proven to be a convenient tool for this task. The lack of self-consistency in this model is well traded off by the effectiveness in capturing the essential physics. Recent theoretical investigation [7] have led to the identification of the selection rules for electromagnetic transitions in chiral partner bands, which can be verified directly in experiments. Additional symmetries of the model hamiltonian have led to the identification of a new quantum number for the restored states in the laboratory reference frame. The impact of these discoveries on future studies will be addressed.

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